

In the event of any doubt or misunderstanding arising from this translation, the standard in Thai will be held to be authoritative.

Unofficial Translation  
**TIS 1693-2547 (2004)**  
**Thai Industrial Standard**  
**for**  
**Instantaneous Water Heaters : Safety requirements**

### 1. Scope

This standard specifies the safety of electric **instantaneous water heaters** for household and similar purposes and intended for heating water below boiling temperature, their **rated voltage** being not more than 250 V for single-phase appliances and 480 V for other appliances.

***NOTE 101** Instantaneous water heaters incorporating bare heating elements are within the scope of this standard.*

Instantaneous water heaters not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended for use in shops, in light industry and on farms, are within the scope of this standard.

As far as is practicable, this standard deals with the common hazards presented by instantaneous water heaters which are encountered by all persons in and around the home. However, in general, it does not take into account

- the use of instantaneous water heaters by young children or infirm persons without supervision;
- playing with instantaneous water heater the by young children.

***NOTE 102** Attention is drawn to the fact that*

- *for instantaneous water heaters intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary.*

***NOTE 103** This standard does not apply to*

- *appliances for boiling water (IEC 60335-2-15);*
- *storage water heaters (IEC 60335-2-21);*

- *appliances intended exclusively for industrial purposes;*
- *appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas);*
- *commercial dispensing appliances and vending machines (IEC 60335-2-75).*

## **2. Normative references**

This clause of Safety of household electrical appliance : General requirements TIS 1375 clause 2. is applicable.

## **3. Definitions**

This clause of TIS 1375 clause 3. is applicable except as follows.

### **3.1.9 Replacement:**

Normal operation

Operation of the instantaneous water heaters while supplied with water, the flow being adjusted to attain the highest outlet water temperature without operation of the thermal cut-out

### **3.101 Instantaneous water heater**

Stationary appliance for heating water while it flows through the appliance

***NOTE** Instantaneous water heaters are referred to as "water heaters".*

### **3.102 Closed water heater**

Water heater intended to operate at the pressure of the water system, the flow of water being controlled by one or more valves in the outlet system

***NOTE** The operating pressure may be the output pressure of a reducing or boosting device.*

### **3.103 Open-outlet water heater**

Water heater in which the flow of water is controlled by a valve in the inlet pipe, there being no valve in the outlet pipe

**3.104** Bare-element water heater

Water heater in which uninsulated heating elements are immersed in the water

**3.105** Rated pressure

Water pressure assigned to the water heater by the manufacturer

**3.106** Flow switch

Switch that operates in response to a flow of water

**3.107** Pressure switch

Switch that operates in response to a change in pressure

#### **4. General requirement**

This clause of TIS 1375 clause 4. is applicable.

#### **5. General conditions for the tests**

This clause of TIS 1375 clause 5. is applicable except as follows.

**5.2** *Addition.*

*NOTE 101 Additional samples may be required for the tests of 22.109.*

**5.3** *Addition:*

When the tests are carried out on a single water heater, the tests of 22.102, 22.107, 22.108 and 24.102 are carried out before the tests of Clause 19.

**5.7** *Addition:*

Water having a temperature of  $15\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  is used for the tests.

#### **6. Classification**

This clause of TIS 1375 clause 6. is applicable except as follows.

**6.1** *Modification:*

Bare-element water heaters shall be class I or class III.

Other water heaters shall be class I, class II or class III.

**6.2 Addition:**

Water heaters shall be at least IPX1.

*NOTE 101 A higher degree of protection may be required depending on the zone in which the water heater is installed, as specified in IEC 60364.*

## 7. Marking and instructions

This clause of TIS 1375 clause 7. is applicable except as follows.

**7.1 Addition:**

*NOTE 101 The minimum rated frequency for bare-element water heaters is 50 Hz.*

Water heaters shall be marked with the rated pressure in pascals.

Bare-element water heaters shall be marked with the substance of the following:

The water resistivity must not be less than...  $\Omega\text{cm}$ .

*NOTE 102 The value of the water resistivity is not to exceed 1 300  $\Omega\text{cm}$ . at a temperature of 15 °C.*

**7.12 Addition:**

The instructions for open-outlet water heaters to be used with a spray head shall state that the spray head must be descaled regularly.

The instructions shall include the substance of the following:

WARNING: Do not switch on if there is a possibility that the water in the heater is frozen.

*NOTE 101 This warning is not required if the water heater incorporates a flow switch.*

**7.12.1 Addition:**

The installation instructions for open-outlet water heaters shall state that the outlet must not be connected to any tap or fitting other than those specified.

If a pressure relief device is required for closed water heaters, the

instructions shall state that it must be fitted during installation, unless it is incorporated in the water heater.

The installation instructions for bare-element water heaters shall state the substance of the following:

- the resistivity of the water supply must not be less than ...  $\Omega\text{cm}$ ;
- the water heater must be permanently connected to fixed wiring;
- the water heater must be earthed (for **class I water heater** only).

When bare-element water heaters cannot be emptied, the installation instruction shall state that the water heater is not to be installed in locations where freezing can occur.

**7.15 Addition:**

The additional markings for bare-element water heaters shall be visible during the installation of the bare-element water heaters.

**7.101** The water inlet and water outlet shall be identified. This identification shall not be on detachable parts. If colours are used, blue shall be used for the inlet and red for the outlet.

*NOTE Identification may be by means of arrows showing the direction of the water flow.*

Compliance is checked by inspection.

**7.102** Class I bare-element water heaters shall be marked to state that the bare-element water heaters must be earthed.

Compliance is checked by inspection.

*NOTE The marking may be on a removable label or tag attached to the the bare-element water heaters.*

## **8. Protection against access to live parts**

This clause of TIS 1375 clause 8. is applicable except as follows.

**8.1.5 Addition:**

*NOTE 101 The connections to the water mains and electrical supply are assumed to be in position during the test.*

The requirement does not apply to wall-mounted water heaters intended to be permanently connected to fixed wiring by cables having a nominal

cross-sectional area more than 2,5 mm<sup>2</sup>. However, the cross-sectional area of the cable entry shall not exceed 25 cm<sup>2</sup> and there shall be no accessible live parts within the projection of the opening.

### **9. Starting of motor-operated appliances**

This clause of TIS 1375 clause 9. is applicable.

### **10. Power input and current**

This clause of TIS 1375 clause 10. is applicable.

### **11. Heating**

This clause of TIS 1375 clause 11. is applicable except as follows.

#### **11.7 Replacement:**

The water heater is operated until steady conditions are established.

### **12. Void**

### **13. Leakage current and electric strength at operating temperature**

This clause of TIS 1375 clause 13. is applicable except as follows.

#### **13.2 Addition:**

**Bare-element water heaters** are tested with water having the resistivity marked on the bare-element water heaters.

*NOTE 101 The appropriate resistivity may be obtained by adding ammonium phosphate to the water.*

For class I bare-element water heaters, the leakage current is measured between a metal sieve positioned in the water 10 mm from the orifice of the outlet, and the earthing terminal. For single-phase water heaters, the terminals of the heating element are connected through the selector switch to each pole of the supply in turn, as shown in Figure 101. For three-phase water heaters, the earthing terminal is connected to the

neutral conductor, as shown in Figure 102.

The leakage current shall not exceed 0,25 mA.

#### **14. Transient overvoltages**

This clause of TIS 1375 clause 14. is applicable.

#### **15. Moisture resistance**

This clause of TIS 1375 clause 15. is applicable except as follows.

##### **15.1.2 Addition:**

Wall-mounted water heaters are fixed at a distance of 3 mm from the mounting surface, unless the installation instructions specify a larger value.

#### **16. Leakage current and electric strength**

This clause of TIS 1375 clause 16. is applicable except as follows.

##### **16.2 Addition:**

Bare-element water heaters are tested with water having the resistivity marked on the bare-element water heaters.

#### **17. Overload protection of transformers and associated circuits**

This clause of TIS 1375 clause 17. is applicable.

#### **18. Endurance**

This clause of TIS 1375 clause 18. is not applicable.

#### **19. Abnormal operation**

This clause of TIS 1375 clause 19. is applicable except as follows.

**19.2** Not applicable.

**19.3** Not applicable.

#### **19.4 Addition:**

For open-outlet water heaters, flow switches and pressure switches that operate during the test of Clause 11 are short-circuited, the water-control valve being adjusted to the most unfavourable position.

*NOTE 101 The closed position of the valve may be the most unfavourable position.*

Flow switches of closed water heaters are short-circuited and any pressure relief device rendered inoperative, the outlet valve being closed. However, if the water heater has no flow switch and back-siphonage is likely to occur, the water heater is filled with just sufficient water to cover the heating element and operated with the outlet valve open.

*NOTE 102 Back-siphonage is not considered likely to occur if a non-return valve or a pipe interrupter is incorporated in the water heater or if the instructions state that a non-return valve has to be included in the installation.*

#### **19.13 Addition:**

*NOTE 101 The water container is considered to be an enclosure.*

During the test of 19.4, the container shall not rupture and the water temperature shall not exceed

- 99 °C, for **open-outlet water heaters** having a capacity exceeding 1 l;
- 140 °C, for **closed water heaters** having a capacity exceeding 1 l.

### **20. Stability and mechanical hazards**

This clause of TIS 1375 clause 20. is applicable.

### **21. Mechanical strength**

This clause of TIS 1375 clause 21. is applicable.

### **22. Construction**

This clause of TIS 1375 clause 22. is applicable except as follows.

## 22.6 *Addition:*

The enclosure shall have a drain hole positioned so that the water can drain without impairing the electrical insulation, unless condensed water cannot accumulate within the enclosure in normal use. The hole shall be at least 5 mm in diameter or 20 mm<sup>2</sup> in area with a width of at least 3 mm.

Compliance is checked by inspection and by measurement.

## 22.33 *Addition:*

The requirement does not apply to **bare-element water heaters**.

**22.101** The **rated pressure of closed water heaters** shall be at least 0,6 MPa.

The **rated pressure of closed water heaters** intended to be supplied by a pressure reducing valve shall be at least 0,1 MPa.

*NOTE* The rated pressure of open-outlet water heaters is 0 Pa.

Compliance is checked by inspection.

**22.102** Water heaters shall withstand the water pressure occurring in normal use.

Compliance is checked by subjecting the water heater to a water pressure of

- twice the rated pressure, for closed water heaters;
- 0,15 MPa, for open-outlet water heaters.

If an open-outlet water heater incorporates a valve that regulates the water flow, a water pressure of 2 MPa is applied to the inlet of the water heater, the valve being closed.

Pressure relief devices are rendered inoperative. The pressure is raised at a rate of 0,13 MPa/s to the specified value and maintained for 5 min.

Water shall not leak from the water heater and there shall be no permanent deformation to such an extent that compliance with this standard is impaired.

**22.103** **Closed water heaters** having a capacity exceeding 3 l shall be supplied with a pressure relief device that prevents excessive pressure.

Compliance is checked by inspection and by subjecting the water heater to a slowly increasing water pressure.

The pressure relief device shall operate before the water pressure exceeds the rated pressure by more than 0,1 MPa.

*NOTE* The pressure relief device may be fitted during installation.

**22.104** The outlet of **open-outlet water heaters** shall be constructed so that the water flow is not limited to such an extent that the container is subjected to a significant pressure in normal use.

Compliance is checked by inspection.

*NOTE The requirement is considered to be met if the cross-sectional area of the water outlet is not less than that of the inlet.*

**22.105** Water heaters incorporating a **flow switch** shall be constructed so that if there is no water flow, the heating element cannot be switched on, and it is switched off if the water flow ceases.

Compliance is checked by inspection and by manual test.

**22.106** **Closed water heaters** shall incorporate a **thermal cut-out** that operates independently from a **thermostat** or **flow switch**. It shall only be possible to reset the **thermal cut-out** after removal of a **non-detachable cover**.

If the capacity does not exceed 1 l and the water heater incorporates a **flow switch**, an alternative **protective device**, such as a **pressure switch**, may be used instead of the **thermal cut-out**.

Compliance is checked by inspection.

**22.107** Water shall not attain an excessive temperature in normal use.

Compliance is checked by the following test.

The water heater is operated at rated power input. Any regulating valve is fully opened and the water flow is adjusted so that the flow switch or pressure switch is on the verge of operating.

The temperature of the outlet water shall not be higher than 95 °C and shall not exceed the temperature of the inlet water by more than 75 K.

For water heater intended to supply water for showering only, the test is carried out under normal operation and with a water pressure of 0,2 MPa. The temperature of the water at the outlet shall not exceed 55 °C.

**22.108** The outlet water of water heaters intended to supply water for showering only shall not attain an excessive temperature due to a sudden pressure drop in the water supply.

Compliance is checked by the following test.

The water heater is supplied with water at a pressure of 0,4 MPa. It is

operated at rated power input with the regulating valve adjusted so that the outlet water temperature is  $25\text{ K} \pm 1\text{ K}$  above the inlet water temperature. The water pressure is then reduced to 0,2 MPa within 1 s.

The outlet water temperature shall not rise by more than 25 K within 10s.

The outlet water temperature is measured by means of a fine-wire thermocouple placed in the centre of a plastic cylindrical receptacle having a diameter of 30 mm and a height of 12 mm. The receptacle is positioned 25 mm below the shower head.

**22.109** Water containers of **open-outlet water heaters** having a **pressure switch** shall not rupture due to excessive internal pressure.

Compliance is checked by inspection and for

- water heaters having a weak part that is ejected or ruptures when the pressure is excessive, by the test of 22.109.1;

*NOTE 1 Examples of weak parts are diaphragms and plugs.*

- water heaters having other means for relieving pressure, by the tests of 22.109.1 and 22.109.3;
- water heaters having heating elements that
  - rupture before the internal pressure is excessive, or
  - cannot be energized when the internal pressure is excessive, by the tests of 22.109.2 and 22.109.3.

After the tests, the water heater shall comply with Clauses 8 and 16.2.

*NOTE 2 The tests simulate a blocked outlet or frozen water in the container.*

*NOTE 3 When carrying out the tests, precautions have to be taken against the consequences of explosive rupture.*

22.109.1 The water heater is filled with water, the water outlet being sealed. The water pressure is then steadily increased.

The weak part shall be ejected or rupture, or the pressure relief device operate, before the internal pressure reaches 1,1 MPa.

After the pressure has been relieved, water is allowed to flow for a period of 1 min.

22.109.2 The water heater is filled with water, the water outlet being sealed and the inlet valve closed. Controls are short-circuited or open-circuited, whichever is more unfavourable. The water heater is then operated at

rated power input.

The heating element shall rupture without causing a hazard unless it remains de-energized.

If the heating element ruptures, the inlet valve is opened and the water pressure steadily increased until it reaches 1,1 MPa. The pressure is maintained for 1 min.

- 22.109.3 The water heater is filled with water, the water inlet and outlet being sealed. Controls are short-circuited or open-circuited, whichever is more unfavourable.

The water heater is placed in an ambient having a temperature not exceeding -5 °C until the water is frozen. The water heater is then placed in the normal ambient and operated at rated power input.

***NOTE** The orientation of the water heater at low temperature is the same as in normal use.*

The heating element shall rupture without causing a hazard or any excessive pressure shall be relieved by means of a pressure relief device, unless the heating element remains de-energized.

The water heater is switched off and allowed to reach room temperature.

If the heating element remains de-energized or has ruptured, water is supplied through the inlet and the pressure is steadily increased until it reaches 1,1 MPa. The pressure is maintained for 1 min.

If a pressure relief device has operated, the water heater is connected to the water supply for a period of 1 min with the outlet still sealed.

- 22.110** Water heaters for wall-mounting shall have reliable provision for fixing to a wall, independent of the connection to the water mains. Compliance is checked by inspection.

### **23. Internal wiring**

This clause of TIS 1375 clause 23. is applicable.

## 24. Components

This clause of TIS 1375 clause 24. is applicable except as follows.

### 24.1.3 *Addition:*

**Flow switches** are tested for 50 000 cycles of operation.

**Pressure switches** for **open-outlet water heaters** and **pressure switches** for water heaters intended to supply water for showering only are tested for 20 000 cycles of operation. **Pressure switches** for other water heaters are tested for 50 000 cycles of operation.

### 24.1.4 *Addition:*

**Thermal cut-outs** incorporated in **closed water heaters** shall comply with the requirements for type 2B controls in Clauses 13, 15, 16, 17 and 20 of IEC 60730-1, unless they are tested with the water heater.

If a **self-resetting thermal cut-out** operates during the test of 22.107, the number of cycles of operation is increased to

- 3 000, for waters heaters intended to supply water for showering only;
- 1 000, for other waters heaters .

**24.101** The **thermal cut-out** or other **protective device** incorporated to comply with 22.106 shall be non-self resetting and, for multi-phase water heaters, provide **all-pole disconnection**.

Compliance is checked by inspection.

**24.102** The **thermal cut-out** or other **protective device**, incorporated for compliance with 22.106 in **closed water heaters** having a capacity not exceeding 1 l, shall maintain its operating characteristics.

Compliance is checked by the following test.

The water heater is supplied at **rated voltage** and operated under **normal operation** but with any control that operates during the test of Clause 11 short-circuited. The water flow is adjusted so that the temperature of the water increases by approximately 1 K per minute.

The **thermal cut-out** is caused to operate five times, the temperatures at which it operates are measured and the mean value determined. The **thermal cut-out** is subjected to 50 000 cycles of temperature fluctuation. Each cycle consists of a variation in temperature between the maximum value measured during the test of 22.107 and half this value.

The **thermal cut-out** is then caused to operate 20 times and the mean value of the temperatures at which it operates shall not deviate by more than 20 % from the mean value previously determined.

If the **protective device** is sensitive to pressure, the water heater is not energized and is subjected to a slowly increasing water pressure. The mean operating pressure of the **protective device** is determined over five cycles. The **protective device** is subjected to 50 000 cycles of pressure fluctuation. Each cycle consists of a variation in pressure between the **rated pressure** of the water heater and half this value.

The **protective device** is then caused to operate 20 times and the mean value of the pressures at which it operates shall not deviate by more than 20 % from the mean value previously determined.

## **25. Supply connection and external flexible cords**

This clause of TIS 1375 clause 25. is applicable except as follows.

### **25.3 Addition:**

**Bare-element water heaters** shall only be provided with means for connection to fixed wiring.

## **26. Terminals for external conductors**

This clause of TIS 1375 clause 26. is applicable.

## **27. Provision for earthing**

This clause of TIS 1375 clause 27. is applicable except as follows.

### **27.1 Addition:**

For **class I water heaters**, metal containers and other metal parts which are in contact with the water shall be permanently and reliably connected to the earthing terminal.

For **class I bare-element water heaters**, the water shall enter and leave through metal pipes that are permanently and reliably connected to the earthing terminal or flow over metal parts that are similarly earthed.

*NOTE 101 Examples of such metal parts are grids or rings.*

## **28. Screws and connections**

This clause of TIS 1375 clause 28. is applicable.

## **29. Clearances, creepage distances and solid insulation**

This clause of TIS 1375 clause 29. is applicable.

## **30. Resistance to heat and fire**

This clause of TIS 1375 clause 30. is applicable except as follows.

**30.2.2** Not applicable.

**30.2.3.1** Not applicable.

**30.2.3.2** *Modification:*

For **bare-element water heaters**, the glow-wire test is carried out as specified for other connections.

## **31. Resistance to rusting**

This clause of TIS 1375 clause 31. is applicable.

## **32. Radiation, toxicity and similar hazards**

This clause of TIS 1375 clause 32. is applicable.